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Effects of advanced nanowire-based targets for nanosecond laser driven acceleration

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An experimental campaign aiming to investigate the effects of innovative nanostructured targets based on Ag and Ni nanowires on laser energy absorption in the ns time domain has been carried out at the LENS (Laser Energy for Nuclear Science) laboratory of INFN-LNS, Catania. Nanowires structures are deemed to increase the light absorption in the visible and infrared range due to plasmonic excitation driven by the incoming photons. The tested targets were realized at INFN-Bologna by anodizing aluminum sheets in order to obtain layers of porous Al2O3 of different thickness, on which nanowires of various metals (Ag and Ni) are grown by electrodeposition with different heights. Targets were then irradiated by Nd:YAG 2J, 6 ns infrared laser (λ=1064 nm) at different pumping energies. Advanced diagnostics tools were used for characterizing the plasma plume and ion production: two IC (ion collectors) for time-of-flight measurements, an X-ray sensitive CCD camera for X-ray imaging and X-ray flux measurements and an ICCD-camera for time resolved optical imaging. A detailed study of irradiated surfaces has been carried out through optical and electron scanning microscopy (SEM).

As compared with targets of pure Al or Al2O3, a huge enhancement (of almost two order of magnitude) of the X-ray flux emitted by the plasma has been observed when using the nanostructured targets, with a corresponding decrease of the "optical range" signal, pointing out the energetic content of the laser produced plasma was remarkably increased. This analysis was furthermore confirmed by TOF spectra.